UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL ENVIRONMENTAL SATELLITE, DATA
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Silver Spring, Maryland 20910

MEMORANDUM FOR: SAF/PAS
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Send To

FROM: Francis G. Hinnant, Col, USAF
Associate Director of Acquisition
NPOESS Integrated Program Office
8455 Colesville Rd, Suite 1450
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SUBJECT: Cross-Track Infrared Sounder (CrIS) FPA Performance and Cross-Track Infrared Sounder (CrIS) Design Performance Papers.
Advances in Large Area Hg1-xCDxTe Photovoltaic Detectors for Remote Sensing Applications

Enclosed are the required ten (10) copies of the subject paper(s) and abstract. These presentation will be given at the SPIE (Society of Photo-Optical Instrumentation Engineers) & IRIS (Military Sensing Symposium). The SPIE will be held April 16 -20, 2001 in Orlando, Florida and the IRIS will be held March 5-7, 2001 in Vienna, VA. The DOD and NASA sponsor these conferences. Mr. Arvind I. D'Souza of the Boeing and Rockwell Science Center, ITT will present both papers. Priyalal Wijewarnasuriya will present the abstract also of the Boeing and Rockwell Science Center. The papers being presented are follow-up to abstracts already approved by SAF/PA.

The program office has reviewed the information in the attached abstracts and found it appropriate for public disclosure without change.

Point of contact on this matter is Mr. Hal Bloom, NPOESS IPO/ADA at 301-427-2084 (Ext. 170).

cc: ADA (E. Kang)

Attachment: Presentation—10 copies

Cross-Track Infrared Sounder FPA Performance

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ABSTRACT

The National Polar-orbiting Operational Environmental Satellite System (NPOESS) Cross-track Infrared Sounder (CrIS) is an interferometric sensor that measures earth radiances at high spectral resolution, using the data to provide pressure, temperature and moisture profiles of the atmosphere. The pressure, temperature and moisture sounding data are used in weather prediction models that track storms, predict levels of precipitation etc. The CrIS instrument contains SWIR ($\lambda_c \sim 5$ µm at 98K), MWIR ($\lambda_c \sim 9$ µm at 98K) LWIRs ($\lambda_c \sim 16$ µm at 81K) Focal Plane Array (FPA) modules. A critical CrIS design selection was the use of photovoltaic (PV) detectors in all three spectral bands. PV detectors have the important benefits of high sensitivity and linearity. Each FPA modules consists of nine large (1000 µm diameter) photovoltaic detectors with accompanying cold preamplifiers. This paper describes the performance for all the modules forming the CrIS Detector Preamplifier Module (DPM).

Molecular Beam Epitaxy (MBE) is used to grow the appropriate bandgap n-type $Hg_{1-x}Cd_xTe$ on lattice matched CdZnTe. SWIR, MWIR and LWIR 1000 µm diameter detectors have been manufactured using the Lateral Collection Diode (LCD) architecture. Custom pre-amplifiers have been designed to interface with the large SWIR, MWIR and LWIR detectors. The operating temperature is above 78K, permitting the use of passive radiators in spacecraft to cool the detectors. Recently fabricated 1000 µm diameter photovoltaic detectors have the measured performance parameters listed in the Table below. Expected D* performance from the detector/pre-amplifier models are also listed in the table. The D* values are calculated at the CrIS program peak wavelength specified for each spectral band.

	SWIR	MWIR	LWIR
T in K	98	98	81
λ_c in µm	5.02	9.89	15.9
R_oA_{opt} in ohm-cm^2	1.3×10^{7}	1.0×10^{2}	9.0×10^{-1}
I_d at V_d = -0.1 V	1.0×10^{-11}	1.0×10^{-6}	1.0×10^{-4}
AR-coated QE in %	90	80	75
λ_p in µm	4.64	8.26	14.0
D* in cm Hz$^{1/2}$/W	7.8×10^{10}	1.1×10^{11}	4.0×10^{10}

Key Words: CrIS, Sounder, Large HgCdTe Detectors

1.0 INTRODUCTION

This document outlines the CrIS Focal Plane Array (FPA) expected performance based on measured detector parameters. Each DPM is comprised of three FPA modules that sense radiation in its assigned infrared band. The three bands of radiation are designated as short-wave infrared (SWIR), mid-wave infrared (MWIR), and long-wave infrared (LWIR). The designations are relational to each other and are not those usually assigned in general infrared technology. This paper presents representative data from a number of 1000 µm diameter photovoltaic detectors that have been fabricated for each of the three spectral bands. Custom preamplifiers have been designed for each of the spectral bands. Noise performance models for the preamplifiers are coupled with calculated and/or measured noise from the detectors to predict the FPA module D* in each spectral band. Mechanical location of the detectors within each FPA module and the location of each FPA module within the DPM are also described.